over the groove made in the soft-iron bars is still less extensible; and finally, when the thread has taken the curvature of the surrounding parts, it opposes any further descent of the armature with the resistance which a stretched thread of india-rubber presents against being pressed or crushed.

This apparatus, to which M. Marey has given the name *electrodynamograph*, has still to receive further improvements, but even as it is, it has already furnished some interesting evidence as to the decrease in volume of the electric waves from the beginning to the end of the discharge; also as to the shape of these waves and the occurrence in the electric tetanus produced by strychnine, &c. Of these different results we shall at present consider only one—the form of a wave is traced by the electro-dynamograph :—an investigation which brings us to the analysis of the wave-phases.

In Fig. 6 the continuous line *b* is the tracing of a single wave obtained with the electro-dynamograph. From it alone we already have evidence that the ascending phase is much more sudden than the descending phase as also takes place in a muscular shock. We can further theoretically complete the curve by taking into account what we have learned by Guillemin's method in the preceding paragraph about the duration of a wave. All that is necessary is to produce downwards the two ascending and descending lines till they intercept between them a distance equal to that which represents (on the time-line) the duration of the whole wave. Thus (Fig. 6) the pointed line *a* represents the actual position of the axis of abscissas and that part of the tracing which the instrument was unable to trace on account of its insufficient sensibility.

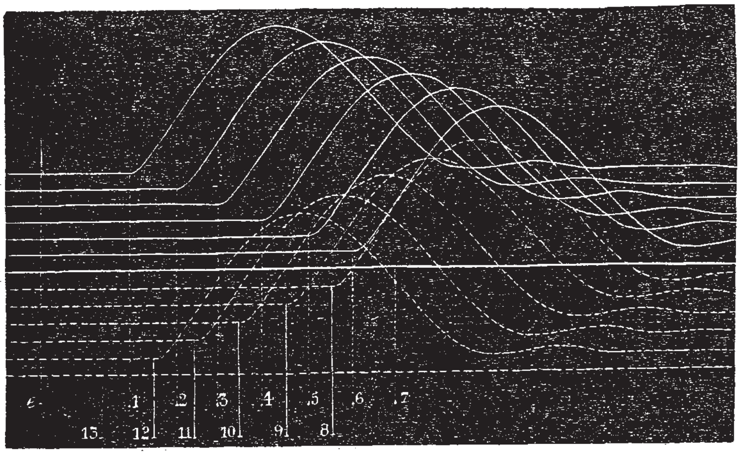

FIG. 4.

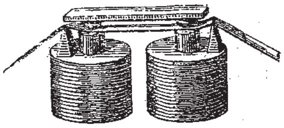

FIG. 5.

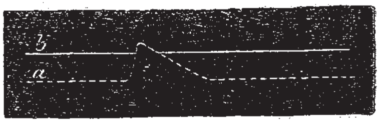

FIG. 6.

It is true that this curve is only probable, but there are great presumptions in favour of its reality. The points of origin and termination can determine it experimentally, as we have seen done by Guillemin's method (see 2).

We can now understand the reason of the special characteristics presented by currents induced in a secondary coil by the waves of a torpedo discharge which have been passed through an inducting coil. The phase of sudden increase of each wave is alone capable of giving birth to an inducted current. FRANCOIS FRANCK

(*To be continued.*)

GEOGRAPHICAL NOTES

AT the meeting of the Geographical Society on Monday, Sir H. Rawlinson read a paper, On the road to Merv from the Caspian. After some interesting remarks on the comparative geography of the eastern shores of the Caspian Sea, Sir Henry read some portion of the Russian letters on the earlier stages of the road to Merv, of which a summary appeared in our last issue, and afterwards gave from Russian official documents an account of two ancient cities, the probable relics of Khowrasmian times—Mestorian, or Mestdovran, and Meshed. The former in past ages was one of the most important cities of Central Asia, if one may judge from the remarkable aqueducts leading into it, which were the chief arteries of an entire system of irrigation canals thoroughly watering the whole country, and from the number of its buildings, the remains of which exist to this day. The course of the aqueduct was explored by General Lomakine's orders some two or three years ago, and was traced to the Sumbar, a tributary of the Attrek, a length of some sixty-five versts. The city of Mestorian appears to have consisted of a citadel and of two other inclosures with thick, high walls built of enormous bricks. The mass of the *débris* at the place is so extensive and in such good preservation, that it would be possible, we are told, to make use of it for building a large new town! The bricks, it may be added, are stated to be as hard as stone, and often carved and ornamented with friezes in relief, arabesques, and well-executed inscriptions; the last are sometimes in various colours, illuminated with flowers, and the letters about seven inches in height. Five versts from Mestorian is another remarkable place, known in the country as Meshed; it is, strictly speaking, an ancient necropolis. Here, according to report, is an open coffer holding the sacred books, a hanging lamp, and vases for ablutions, and although in a desert place and wholly unprotected, no one dreams of touching its contents. Sir Henry Rawlinson afterwards dealt at some length with the geography of the country further to the eastward, more especially with that on the northern slopes of the Attock, which is inhabited by three divisions of the Tekké Turcoman tribes.

WE regret to record the death, on Saturday afternoon, at a comparatively early age, of Commander G. C. Musters, so well known as the explorer of Patagonia. His work, "At Home with the Patagonians," is at present the best authority we have on this inhospitable country and its people, and Mr. Musters, as readers of the work know, obtained his information by living with the Patagonians for many months as their "king," and it was only by a *ruse* that he managed to get away from a people who

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had learned to adore him. Mr. Musters was a fearless explorer, and a man of unfailing tact and winning manners. Two or three years ago Mr. Musters returned from Bolivia, with which little-known country he had made a thorough acquaintance, and had, we believe, collected material for an interesting work. He recently received the appointment of Consul at Mozambique, and was to have left this month for his post, from which, he was delighted to think, he would be able to do some valuable exploring work in the African interior. By his death Her Majesty has lost a faithful and able servant, and science an eager explorer. Musters was loved by every one who had the pleasure of his acquaintance.

THE prosecution of marine surveys on the coasts of India has been for a long time much hampered by the want of a proper surveying steamer, and we are glad to learn from a Bombay paper that a new vessel—the *Investigator*—has just been launched, which will supply the defect. The steamer is well provided with all the necessary appliances for chart-making, deep-sea sounding, &c.

THE November number of the *Bulletin* of the French Geographical Society contains Dr. Jules Crevaux's account of his exploration in the interior of French Guiana in 1877. Dr. Crevaux, with little assistance and in the face of not a few difficulties, ascended the River Maroni, and striking the River Yary, traced its course to its junction with the Amazon. The two main results of his journey are the crossing for the first time of the Tumuc-Humac chain at the level of the sources of the Maroni, and the discovery and complete delineation of the Yary, an important affluent of the Amazon. The Maroni he describes as a fine river of about 140 leagues in length, with a breadth of 1,200 to 1,500 metres at 20 leagues above its mouth, and from 400 to 500 at 90 leagues. The River Yary, Dr. Crevaux considers as more important than the Maroni; it is 150 leagues long, and both rivers are much obstructed by falls and cataracts. Dr. Crevaux gives some very useful notes on the forests of Guiana and the different species of trees which they contain. The highest summits of the Tumuc-Humac range do not exceed 400 metres above sea-level. In summing up his observations on the geology of the region traversed, he says that all the formations met with from the mouth of the Maroni to that of the Yary have an ancient physiognomy. They are mainly composed of schistose rocks which may be divided into three systems, which are, in order of age—1. The gneiss of the mouth of the Maroni. 2. The schists and mica schists of the middle course of the river. 3. The ferruginous schists and quartzites of the Man-Bari and the Yary; these latter are very wide-spread. All these are frequently traversed by granites and trachytes.

THE possibility of water communication between the Obi and the Yenissei seems to be more and more confirmed by further explorations. Baron Aminoff, after having explored the water-parting between these rivers, arrives at the conclusion that the hydraulic works which would be necessary for the construction of a canal with sluices would not present serious difficulties. The canal would be very short, and the marshes at the sources of the Kas and Yazevaya rivers afford a sufficient amount of water.

THE *Golos* of January 22 says it learns that authentic intelligence respecting Prof. Nordenskjöld's Arctic expedition has been received from Baron Fredericbs, Governor-General of Eastern Siberia. According to these advices the steamer *Vega* is ice-bound forty miles from East Cape. The authorities at Jakutsk have been instructed to inform the natives of the dangerous position of the steamer, and to issue a general summons to the people to render assistance to the expedition. At the same time a special expedition has been organised which will attempt to reach the *Vega* by a journey over the ice with the aid of reindeers or dogs. Herr Sibiriakoff has telegraphed to Baron Frederichs, asking him to send a party to the assistance of the Swedish Expedition. He has received a letter from Dr. Lindemann, of Bremen, in which the former says that at the coast where the *Vega* is believed to be lying there is a large native village, and from this village the nearest post of white merchants is distant only about 200 English miles, which may be traversed in winter in three or four days.

A REPORT has been received of a journey by Mr. Baber in the north-west of the Chinese province of Szuchuen. The original intention was to examine, between Suchow and Kiating, the River Tatu, which falls into the Yangtze-Kiang, and then to cross the mountains from Kiating to Fu-lin in long. 103°. At Fu-lin, however, Mr. Baber was induced to extend his exertions into the country further west, and he travelled onwards to a place called Tzu-Tati, the head-quarters of a Sifan chief. Here he heard of the existence of a mountain path to Ta-chien-lu, the French missionary station lying nearest to Tibet. After travelling three days through pine forests, the mountain range was crossed by a snowy pass, and on the northern slope yaks were found grazing, and many slates, inscribed with Sanskrit characters, were noticed. The appearance and language of the people also pointed to the fact that though Tibet proper is many hundred miles west of this point, yet tribes of the Tibetan race and language extend up to the banks of the Tatu River. This confirms the views already expressed by Mr. T. T. Cooper and other travellers.

THE *Japan Gazette* translates an article of some interest from the *Osaka Nippo*, on the subject of Japanese relations with Corea. After commenting on the progress made by Japan during the past few years, the writer remarks that "the Coreans, on the contrary, obstinately cling to the customs of Gio, Wu, and Shin, three Chinese sages who lived 3,000 years ago, and they believe their country is a part of Paradise, next in rank to China, and that western countries are inhabited by barbarians and savages."

COUNT WILCZEK and Lieut. Weyprecht intend to visit the northern coast of Novaya Zemlya in the course of this year, and will remain at that station for a twelvemonth in order to make a series of exact magnetic, electric, hydrographical, and meteorological observations. The cost of the expedition will be defrayed by Count Wilczek himself.

OUR ASTRONOMICAL COLUMN

THE VARIABLE-STAR ALGOL.—Considering the long period during which this star has been under observation, and the many investigations which have been made with the view to reduce its fluctuations of light within some law, much interest attaches to a remark by Prof. Winnecke that the times of *minima* of Algol in the last year have fallen about one hour earlier than those assigned in the ephemerides of variables published by the *Astronomische Gesellschaft*. Dr. Julius Schmidt, director of the Observatory at Athens, to whom we owe the greater number of recent observations on this star, has not yet made known his results for 1878, but we have his determinations of the times of *minima* in 1875-76-77. For comparison with them we may take the last formula given by Prof. Schönfeld in his second catalogue of the variable stars, which appeared in 1875, viz., for Paris mean time:—

Min. ... 1869, Nov. 9, 3h. 39m. 34s. + 2d. 20h. 48m. 53s·67 E.

The following are the differences from the observed times of *minima*, during the last six months of each year, wherein the observations are most numerous:—

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